

DOE/IG-0539

AUDIT  
REPORT

PASSIVE MAGNETIC RESONANCE  
ANOMALY MAPPING AT  
ENVIRONMENTAL MANAGEMENT SITES



JANUARY 2002

U.S. DEPARTMENT OF ENERGY  
OFFICE OF INSPECTOR GENERAL  
OFFICE OF AUDIT SERVICES



U. S. DEPARTMENT OF ENERGY  
Washington, DC 20585

January 11, 2002

MEMORANDUM FOR SECRETARY

FROM: Gregory H. Friedman (Signed)  
Inspector General

SUBJECT: INFORMATION: Audit Report on "Passive Magnetic Resonance Anomaly Mapping at Environmental Management Sites"

BACKGROUND

The Department of Energy's Office of Environmental Management supports the development and deployment of innovative environmental cleanup technologies. Environmental Management's Office of Science and Technology (OST) manages and directs a national program that provides the scientific foundation, new approaches, and new technologies that are intended to significantly reduce the risk, cost, and schedule for completion of the Department's cleanup mission. OST's policy is to perform peer reviews to evaluate the technical merit and plausibility of new technologies prior to expending Department resources on field tests.

In January 2000, several Environmental Management field sites began conducting tests of Passive Magnetic Resonance Anomaly Mapping (PMRAM). PMRAM is a non-intrusive characterization technology that attempts to map the underground location of groundwater, faults, fractures, buried objects, and chemicals. This technology is unique in that it combines an electronic system and a human operator into a single bio-sensory unit by connecting the operator at the wrists to an electronic system, which is harnessed to the body. The technology relies on the ability of the world's only qualified operator, a resident of the Ukraine, to sense changes in magnetic fields.

The objective of the audit was to determine whether the OST evaluated the technical merit and plausibility of PMRAM technology before field tests began.

RESULTS OF AUDIT

The Department spent over \$400,000 to field test PMRAM prior to any OST evaluation of the merits and plausibility of the technology. In fact, OST was not even aware that field tests of the PMRAM technology had been conducted until Fiscal Year (FY) 2001.

In FY 2001, OST funding was requested to continue testing PMRAM at other Environmental Management field locations. Once funding was requested, OST performed a peer review of the PMRAM technology. The

peer review concluded that the technology:

- appeared to be implausible;
- did not allow for a scientifically-based evaluation;
- provided no useful information during the three field demonstrations; and,
- appeared inadequate as a site-characterization tool.

We concluded that, had a peer review been performed prior to testing, the Department could have avoided spending over \$400,000 on this technology.

The report includes several recommendations designed to ensure compliance with the Department's philosophy of evaluating the viability of new technologies before they are implemented in costly field tests.

#### MANAGEMENT REACTION

Management agreed with the audit finding and agreed to implement corrective actions to address specific recommendations included in the report. Further, management stated that field testing of the PMRAM technology has been discontinued.

Attachment

cc: Deputy Secretary  
Under Secretary for Energy, Science and Environment  
Assistant Secretary for Environmental Management

# PASSIVE MAGNETIC RESONANCE ANOMALY MAPPING AT ENVIRONMENTAL MANAGEMENT SITES

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# OVERVIEW

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## INTRODUCTION AND OBJECTIVE

The Office of Science and Technology (OST), located within the Department of Energy's (Department) Office of Environmental Management (EM) supports the development and deployment of innovative environmental cleanup technologies. The mission of the OST is to manage and direct a national, solution-oriented science and technology program that provides the scientific foundation, new approaches, and new technologies that bring about significant reductions in risk, cost, and schedule for completion of the Department's cleanup mission. The OST's policy is to perform peer reviews to evaluate the technical merit and plausibility of new technologies before investing in field tests.

In January 2000, the EM began conducting field tests of Passive Magnetic Resonance Anomaly Mapping (PMRAM). PMRAM is a characterization technology that attempts to map the underground location of groundwater, faults, fractures, buried objects, and chemicals. This non-intrusive technology combines an electronic system and a human operator into a single bio-sensory unit. As illustrated on page 3 of this report, the operator is connected at the wrists to the electronic system, which is harnessed to the body. The technology relies on the ability of the operator to sense changes in magnetic fields. As of September 2000, the world's only qualified operator was a resident of the Ukraine. Specifics on the interaction between the operator and the electronic system are considered proprietary or have not been developed.

The objective of the audit was to determine whether the OST evaluated the technical merit and plausibility of PMRAM technology before field tests began.

## CONCLUSIONS AND OBSERVATIONS

The OST did not evaluate the technical merits and plausibility of PMRAM technology before field tests began. EM sites were not required to obtain peer reviews from the OST unless OST funds were used for the field tests. In this case, OST funds were not required; thus, a peer review was not performed. However, the OST performed a peer review after the field tests were completed and concluded that the PMRAM technology "appears to be implausible" and does not allow for a scientifically based evaluation. As a result, the Department incurred \$408,750 in avoidable costs for field tests of PMRAM technology.

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In April 1998, the Office of Inspector General issued Report DOE/IG-0419, *The Department of Energy's Peer Review Practices*, which evaluated whether the Department had established and was managing a peer review process for evaluating scientific and technical projects. The report concluded that at the three laboratories reviewed, the Department had established and was managing a peer review process in accordance with administration policy and Office of Management and Budget requirements for scientific and technical projects.

This audit identified issues that management should consider when preparing its year-end assurance memorandum on internal controls.

(Signed)  
Office of Inspector General

## FIELD TESTS

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### **Field Tests Were Performed Before OST Evaluated PMRAM Technology**

Three EM sites performed field tests of PMRAM technology before OST evaluated its technical merit and plausibility. The tests were conducted at the East Tennessee Technology Park (ETTP) in Oak Ridge, Tennessee, and the Fernald and Ashtabula Environmental Management Projects (FEMP and AEMP) in Ohio, between January 2000 and July 2000. The objective of the field tests was to determine if PMRAM technology could locate contaminated areas non-intrusively. The field tests did not confirm that the technology was feasible. For example, the final report prepared by Bechtel Jacobs Company LLC regarding the performance evaluation at ETTP concluded "there is probably no application to soils at this time." Additionally, the report states "results indicate PMRAM could be considered as a screening tool to determine the presence of VOC-contaminated groundwater; however, it is likely to underestimate the extent of the contamination."

#### PMRAM Field Testing Activities at ETTP



### **OST's Policy Is to Perform Peer Reviews Prior to Field Tests**

The OST's *Implementation Guidance for the Technical Peer Review Process*, dated October 1999, required that a peer review be conducted prior to field tests of OST funded technologies. To address concerns of external review groups such as the General Accounting Office and National Research Council, the OST initiated an office-wide technical peer review program. The objective of this program is to provide the

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OST with uniform, independent, and unimpeachable technical reviews on a timely basis, and to assess the scientific and engineering merits of technology development activities. These technical peer reviews provide an essential management tool in determining the scientific and engineering merits of technologies and systems in which the OST has placed its investments.

**EM Sites Were Not Required to Obtain Peer Reviews Unless OST Funds Were Used**

Although it was the OST's policy to conduct peer reviews prior to investing in field tests, the EM sites were not required to obtain reviews unless OST funds were used to pay for the field tests. In this case, the Oak Ridge Operations Office and the Ohio Field Office used closure funds rather than OST funds to field test PMRAM. Thus, the EM sites did not request a peer review.

In addition, the Ohio Field Office inappropriately used OST funds obtained for other approved OST projects to reimburse the cleanup contractor for supporting the PMRAM activity at the FEMP. In March 2000, the Ohio Field Office submitted a proposal to the OST, to acquire funding for a suite of innovative technologies relating to intrusive and non-intrusive characterization through concrete walls and floors. PMRAM was not included in the suite of technologies submitted by the Ohio Field Office. However, because the funding was small and PMRAM was a characterization technology, the Technical Program Officer believed it was within his discretion to use these funds and did not request Headquarters' approval. According to OST policy, Headquarters' approval is required prior to using OST funds on technologies that have not been approved.

**Unnecessary Costs Were Incurred**

The Department incurred \$408,750 in avoidable costs for field testing the PMRAM technology. The Oak Ridge Operations Office spent \$218,750 at the ETTP, and the Ohio Field Office spent \$190,000 at the AEMP and FEMP. The Department's EM cleanup contractors retained the majority of the Department's payments for the field tests. For example, the Oak Ridge Operations Office paid \$99,455 to the subcontractor that did the actual mapping, and \$119,300 to Bechtel Jacobs Company LLC for its support of the subcontractor.

OST was not aware of the sites' PMRAM activities until the Office of the Deputy Assistant Secretary for Site Closure requested OST funding for the PMRAM technology in FY 2000. At that time, the OST performed a peer review using a team of experts in the fields of hydrology, geology, chemistry, and engineering. The review team



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concluded that the PMRAM technology did not appear plausible and did not allow for a scientifically based evaluation. In addition, information was not provided to the review panel to enable them to understand the physical phenomena involved in PMRAM. Further, the panel's report states that no useful information was developed during the three field demonstrations, and the PMRAM technology appeared inadequate as a site-characterization tool. The panel concluded that PMRAM should not be considered for further deployment. Finally, the Director of EM's Office of Technology Application stated that if the peer review had been conducted first, the OST would not have funded the field work for the PMRAM based on the peer review results.

## **RECOMMENDATIONS**

We recommend that the Assistant Secretary for Environmental Management establish policy to require that EM sites:

1. Coordinate with the OST prior to investing in unproven cleanup technologies to determine the appropriate extent and type of review;
2. Use OST funds only for technologies that have been approved by the OST; and,
3. Discontinue field-testing of the PMRAM technology.

## **MANAGEMENT REACTION**

Management agreed with the audit findings and recommendations and agreed to implement corrective actions. Further, management stated that field testing of the PMRAM technology has been discontinued.

## **AUDITOR COMMENTS**

Management's comments were responsive to the audit report.

## Appendix 1

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### SCOPE

The audit was performed from October 19, 2001, to November 16, 2001, at Department of Energy Headquarters in Washington, D.C. Additionally, we obtained information regarding Passive Magnetic Resonance Anomaly Mapping (PMRAM) technology from the Oak Ridge Operations Office, East Tennessee Technology Park, Ohio Field Office, Ashtabula Environmental Management Project, and Fernald Environmental Management Project. The scope of the audit included costs incurred for researching the PMRAM technology from January 2000 to September 2001.

### METHODOLOGY

To accomplish the audit objective, we:

- Reviewed the Department's *Implementation Guidance for the Technical Peer Review Process, Version 3.0*;
- Analyzed Technical Peer Review Report, *Passive Magnetic Resonance Anomaly Mapping*, prepared by the American Society of Mechanical Engineers;
- Reviewed Department contracts for PMRAM demonstration; and,
- Interviewed Departmental and contractor personnel regarding the PMRAM technology.

We conducted the audit according to generally accepted Government auditing standards for performance audits and included tests of internal controls and compliance with laws and regulations to the extent necessary to satisfy the audit objective. Accordingly, we assessed the significant internal controls related to the management of the PMRAM activities. Because our review was limited, it would not necessarily have disclosed all internal control deficiencies that may have existed at the time of our audit. Computer processed data was not used, and therefore, we did not perform any tests on the data. In addition, we reviewed the implementation of the Government Performance and Results Act of 1993. While no specific performance measures were established for PMRAM, the Department's Fiscal Year 2001 Strategic Plan emphasizes the importance of peer reviews, scientific advisory committees, and the advancement of science and technology in order to solve currently intractable cleanup problems.

The Office of Environmental Management waived the exit conference on January 2, 2002.

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(8-89)  
EFG (07-90)

United States Government

Department of Energy

# memorandum

DATE: December 19, 2001  
REPLY  
ATTN OF: EM-30 (W. Murphie, 301-903-7216)  
SUBJECT: Response of the Office of Environmental Management to Office of Inspector General Draft Audit Report on the "Passive Magnetic Resonance Anomaly Mapping at Environmental Management Sites"  
TO: Terry L. Brendlinger, Manager, Eastern Regional Audit Office, OR

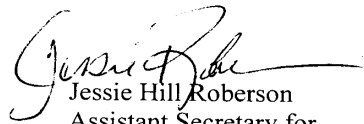
Thank you for working with us on this review and for the opportunity to provide comments before you finalize the report and associated recommendations. As discussed with your staff on December 11, 2001, we have the following comments on the draft audit report.

First, we request that you modify the first recommendation regarding peer reviews as currently written. We understand the importance of peer review and that in this particular case, we did not use the peer review process prior to field testing. Notwithstanding, we firmly believe that DOE needs to retain the flexibility and discretion to pursue the application of technologies without peer review, as appropriate. We offer the following rewording for the first of the three recommendations: "Coordinate with the Office of Science and Technology (OST) prior to investing in unproven technologies to determine the appropriate extent and type of review."

Second, we agree with the other two recommendations regarding funding of technologies approved by the OST and field testing of PMRAM. With regard to the recommendation to discontinue field testing of the PMRAM technology, this has already occurred.

Additional written comments are attached. These comments have been coordinated with the Office of Site Closure (EM-30), the OST (EM-50), the Ohio Field Office and the Oak Ridge Operations Office.

We appreciate the opportunity to discuss the audit with your staff and comment on the draft report. We look forward to receiving your revised report and would be happy to discuss any further questions you may have. If you require additional assistance, please contact Carol Hunt-Heartley at 202-586-1662.

  
Jessie Hill Roberson  
Assistant Secretary for  
Environmental Management

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3. What format, stylistic, or organizational changes might have made this report's overall message more clear to the reader?
4. What additional actions could the Office of Inspector General have taken on the issues discussed in this report which would have been helpful?

Please include your name and telephone number so that we may contact you should we have any questions about your comments.

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